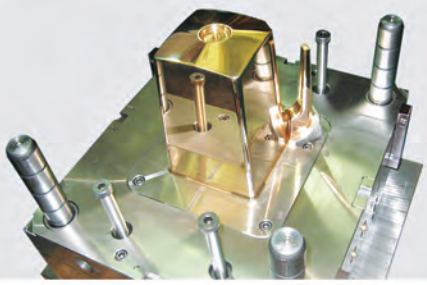
100 YEARS OF AMPCO®

HIGH CONDUCTIVITY COPPER ALLOYS
FOR PLASTIC INJECTION AND BLOW MOLDING

Reduce Cycle Time 15 to 40 %
Lower Machining Costs
Improve Product Quality

AMPCOLOY®



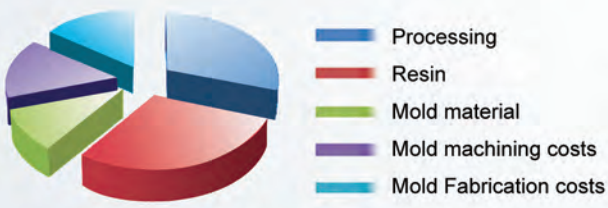
AMPCO METAL EXCELLENCE IN ENGINEERED ALLOYS

AMPCO OFFERS A VARIETY OF ENGINEERED MOLD MATERIALS TO FIT EVERY NEED

Our innovative alloys in mold technology have a direct impact in your work:

MOLD MAKER NEEDS	PLASTICS PROCESSOR NEEDS
• Good machinability • Reduced manufacturing time • Surface finish capability and etching characteristics • Low manufacturing cost	• Mold productivity, reduced cycle time • Low scrap rate - end product • Mold durability • Easy and low-cost maintenance

The different needs in the value chain are not contradictory but complementary! Mold makers want that their Plastics Processor's customers are satisfied with the mold's performance and come back to place more orders.
AMPCO is the right choice for unmatched customer support and service in material selection to achieve the highest performance at both levels of the business system.
(i) The right combination of strength and conductivity.
(ii) Good machinability and easy polishability.
(iii) Durability and low cost maintenance that provide at the same time important benefits for the mold maker and the plastics processor.



The AMPCO high-thermal mold material cost is minimal compared to the costs of a plastics part. With AMPCO® materials the mold maker and the plastics processor will generate substantial costs savings:
- During the fabrication of the mold
- In service and during repairs
- As well as low production rejection rates

MINIMIZE COMPONENT JAMMING AND REMOVE HEAT

When using AMPCO® alloys for wear components such as wear plates, rings, ejector pins, etc., jamming of components can be avoided, thus greatly extending the life of the mold. The exceptional inherent properties of AMPCO® alloys, as well as our rigorous standards of production, make such outstanding performance possible. *AMPCO® 18, AMPCO® 21 and AMPCO® M4 are also used in the mold cavity to remove heat.*

ALLOY	THERMAL CONDUCTIVITY W/mK (BTU/ft hr °F)	THERMAL DIFFUSIVITY MM^2/S (ft^2/hr)	HARDNESS BRINELL (ROCKWELL B/C)	TENSILE STRENGTH MPa (KSI)	YIELD STRENGTH MPa (KSI)	ELONGATION %	COEFFICIENT OF EXPANSION 10^{-6} 1/K (10^{-6} 1/°F)	COEFFICIENT OF FRICTION (DRY CONDITIONS)
AMPCO® 18	63 (37)	19.8 (0.77)	192 (92B)	724 (105)	358 (52)	14	16 (9)	0.18
AMPCO® 21	43 (25)	15.2 (0.59)	286 (30C)	758 (110)	414 (60)	1	16 (9)	0.21
AMPCO® M4	42 (24)	12.4 (0.48)	285 (30C)	960 (139)	725 (105)	8	16 (9)	0.23

The above are nominal values. If specific minimum figures are required, please contact your local AMPCO METAL representative.

AMPCO OFFERS THE MOST COMPLETE RANGE OF MOLD MATERIALS

AMPCOLOY High-Conductivity Alloys

	Beryllium-containing Alloys		Beryllium-free Alloys	
Chemical composition (%)	**AMPCOLOY® 83**	**AMPCOLOY® 95**	**AMPCOLOY® 944**	**AMPCOLOY® 940**
Be	2.0	0.5	-	-
Co	0.5	2.0		
Ni			7.0	2.5
Cr			1.0	0.4
Zr				
Si			2.0	0.7
Cu	balance	balance	balance	balance
Mechanical Properties				
Rockwell Hardness (HRB/HRC)	38 C	100 B	29 C	95 B
Brinell Hardness (HBW)	360	240	280	210
Tensile Strength MPa (KSI)	1175 (170)	830 (120)	860 (125)	650 (94)
Yield Strength MPa (KSI)	1000 (145)	550 (80)	725 (105)	500 (73)
Elongation A5 %	4	10	5	12
Physical Properties				
Elec. Conductivity m/Ω•mm² (ft/Ω•in²)	11.6 (24550)	30 (63500)	18 (38100)	28 (59270)
Elec. Conductivity %IACS	20	52	30	48
Thermal Conductivity W/m•K (BTU/ft hr °F)	106 (61)	220 (127)	150 (87)	208 (120)
Elasticity Modutus GPa (KSI)	131 (19000)	130 (18850)	151 (21900)	131 (19000)
Specific Heat J/g•K (BTU/lb °F)	0.42 (0.10)	0.42 (0.10)	0.38 (0.09)	0.38 (0.09)
Density g/cm³ (lbs/in³)	8.26 (0.298)	8.75 (0.316)	8.7 (0.314)	8.71 (0.315)
Working Temperature limit °C (°F)	300 (572)	450 (842)	400 (752)	450 (842)

The above are nominal values. If specific minimum figures are required, please contact your local AMPCO METAL representative.

AMPCO is the obvious choice so that you do not need to explore alternative material options. Through the unique combination of thermal conductivity, up to 10 times greater than tool steel, and strength of our mold materials, our product line of Beryllium-containing and Beryllium-free alloys are your best solution as a mold maker or a plastics processor.

MOLD REQUIREMENTS	MOLD BENEFITS
High heat transfer	- Rapid heat transfer - Short cycle time - High productivity
Uniform heat transfer	- Uniform cooling - Improved plastic part quality - Minimal scrap rate
Long life	- Longer mold life - Low maintenance costs - Less downtime
Easy manufacturing	- Speedy time to market - Reduced manufacturing time - Low mold manufacturing costs

COMPARATIVE CHART

Product	Hardness Brinell(Rockwell B/C)	Thermal Conductivity W/mK (BTU/ft-hr-°F)	Charpy V-Notch Impact Strength J(Ft·lb)	Yield Strength MPa(KSI)	Tenslle Strength MPa(KSI)	Thermal Expansion Coefficient 10^{-6}/K(10^{-6}/°F)
AMPCOLOY® 83	360 (38C)	106 (61)	5 (4)	1000 (145)	1175 (170)	17.5 (9.7)
AMPCO® M4	285 (30C)	42 (24)	20 (15)	725 (105)	960 (139)	16 (9)
AMPCOLOY® 944	280 (29C)	150 (87)	5 (4)	725 (105)	860 (125)	17.5 (9.7)
AMPCOLOY® 95	240 (100B)	220 (127)	16 (12)	550 (80)	830 (120)	17 (9.4)
AMPCOLOY® 940	210 (95B)	208 (120)	48 (35)	500 (73)	650 (94)	17.5 (9.7)
AISI P-20	285 (30C)	29 (17)	24 (18)	900 (130)	1070 (155)	12.6 (7.0)
420 Stainless	480 (50C)	24 (14)	7 (5)	1380 (200)	1725 (250)	11.0 (6.1)
H-13 Tool Steel	425 (45C)	26 (15)	19 (14)	1380 (200)	1725 (250)	12.8 (7.1)

The above are nominal values. If specific minimum figures are required, please contact your local AMPCO METAL representative.

AMPCOLOY® ATTRIBUTES

Excellent corrosion resistance

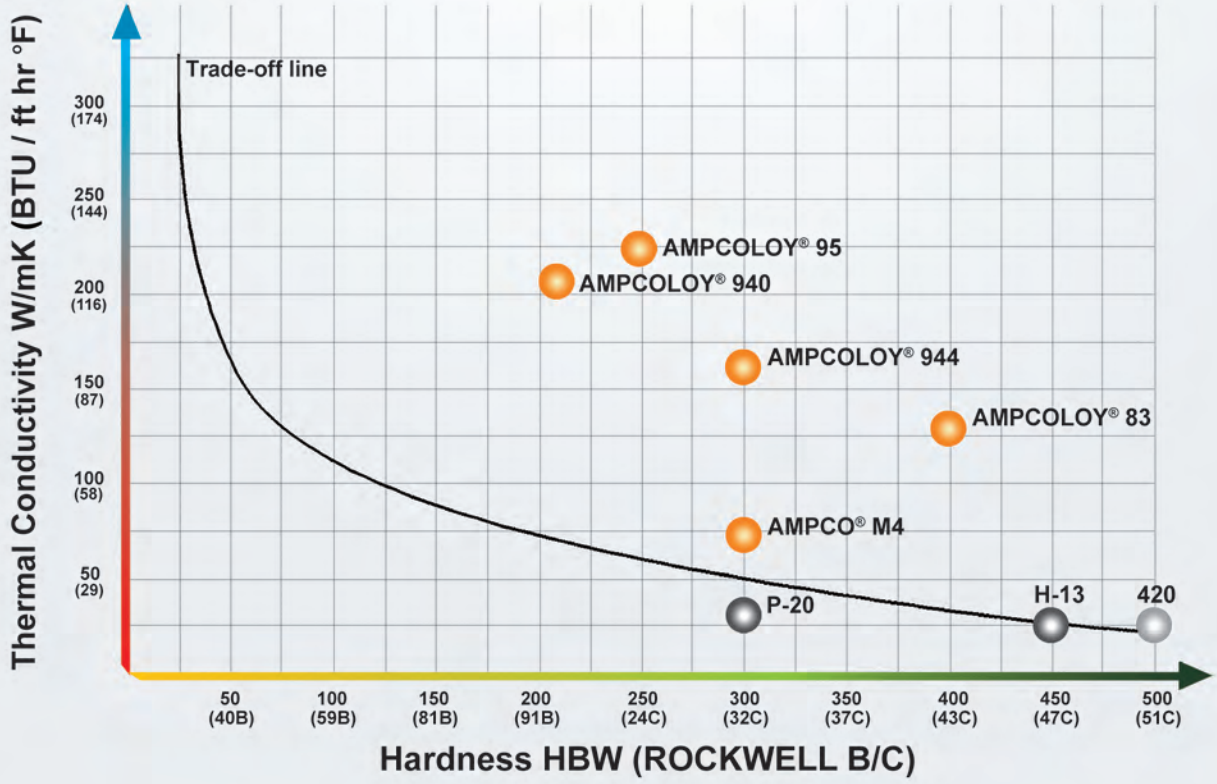
Available in large and thick sizes

Material supplied in fully heat-treated condition

High strength and high thermal conductivity

Good machinability, easy to polish and weld-repairable

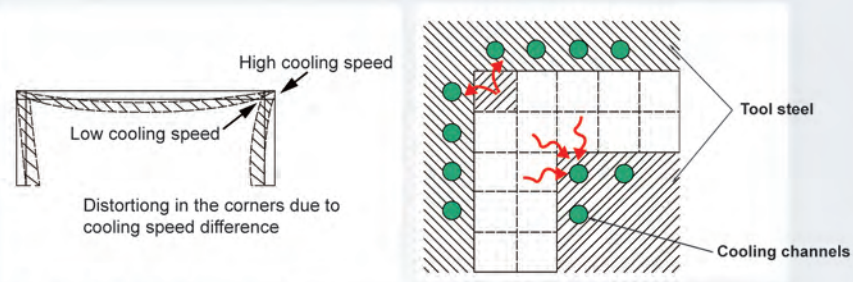
THERMAL CONDUCTIVITY VERSUS HARDNESS



AMPCO THERMAL CONDUCTIVITY ADVANTAGE

With AMPCOLOY® High Conductivity mold materials, as the mold maker, you will generate mold design savings with reduced cooling channels and superior cycle times.

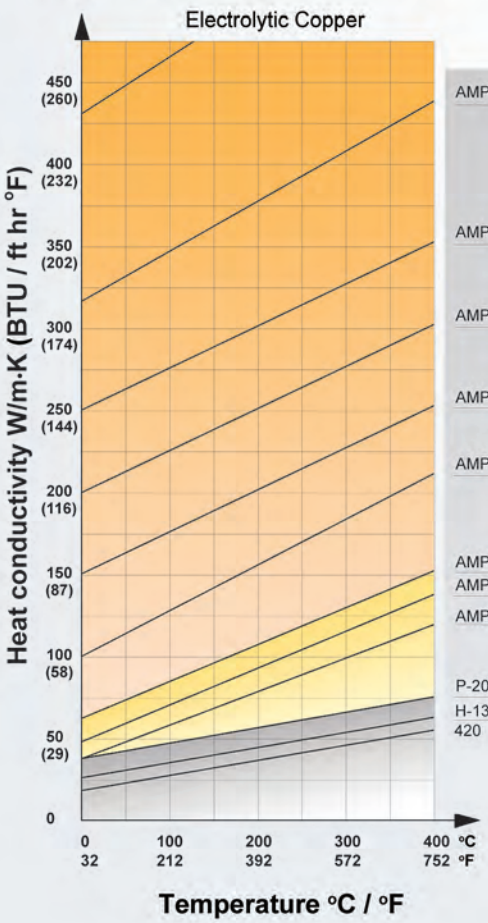
In conjunction, as the plastics processor, you will see cycle times reduced and your overall production increased. The thermal conductivity of our mold materials allows for up to ten times the conductivity of tool steel and provides cycle time reductions of 15% - 40%. The cost savings experienced from these reductions can be substantial and can provide the plastics processor a distinct competitive advantage.



Sketch indicates the typical potential warpage problem in the plastics part if high-thermal mold materials are not applied in the mold, particularly in the cavity.

The THERMAL CONDUCTIVITY of AMPCO MOLD MATERIALS increase with the material working temperature

Heat conductivity and hardness



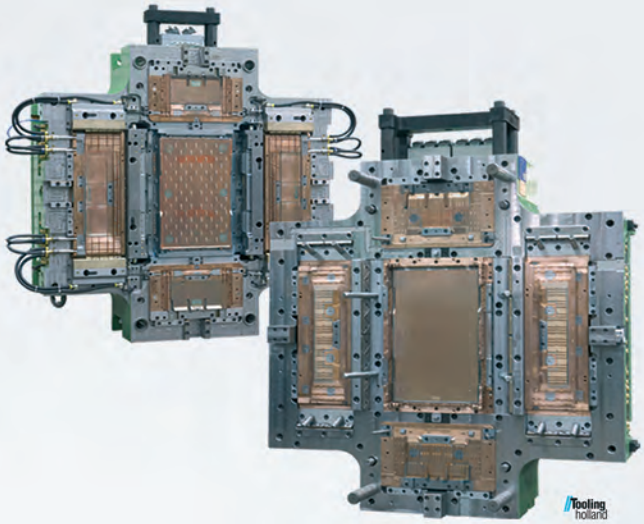
	Hardness	
	Brinell	Rockwell
AMPCOLOY® 972	135	75 B
AMPCOLOY® 95	240	21 C
AMPCOLOY® 940	210	95 B
AMPCOLOY® 944	280	29 C
AMPCOLOY® 83	360	38 C
AMPCO® 18	192	92 B
AMPCO® M4	285	30 C
AMPCO® 21	286	30 C
P-20	285	30 C
H-13	425	45 C
420	490	50 C

The harder copper base tooling material will be the lower thermal conductivity it will have.
The reverse is also true. A low hardness copper base material will generally show high thermal conductivity.

COMMITTED TO INNOVATIVE PRODUCTS AND SUPERIOR CUSTOMER SERVICE FOR 100 YEARS.

AMPCO METAL is an integrated metal producer, offering under the AMPCO® and AMPCOLOY® brands, the widest range of premium specialty bronzes and copper alloys, providing exceptional physical and mechanical properties.

Our family of AMPCOLOY® and AMPCO® alloys provide the best combination of thermal, mechanical and chemical properties to the extent that they are considered the ideal alternative to produce quality plastic parts, when the cooling cycle is critical.



Professional value-added services, product quality and short deliveries are internationally guaranteed through our warehouses in EUROPE, USA, INDIA and CHINA.

Round bar, rectangles, tubes and plates are readily available as well as forged or cast shapes, produced specifcally to your requirements. AMPCO METAL also has the facilities and expertise to deliver pre-machined or fully machined pieces, if required.

UKAS MANAGEMENT SYSTEMS

ADS aerospace sector certification scheme

LLOYD'S REGISTER QUALITY ASSURANCE ISO9001 FRANCE

cofrac

ISO 9001
AS 9120
BUREAU VERITAS Certification

BUREAU VERITAS 1828

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